its appendages, and the other abdominal and thoracic viscera.—Dr. Creighton publishes his observations on the supra-renal bodies based on microscopical investigations of these organs when adult and during development, and shows how they present many features of analogy to the ovaries.—Prof. Humphry gives his reasons for dissent from Dr. Ogston's views on the important share taken by articular cartilage in the growth of bone, as expressed in the July number of the *Journal*.—Prof. Turner describes the placentation of the hog-deer (*Cervus porcinus*).—Dr. Urban Pritchard supplements his previous accounts of the development of the organ of Corti in the internal ear.—Dr. T. B. Henderson, of Glasgow, describes the physiological effects of the inhalation of phosphuretted hydrogen.

Journal de Physique, October.—In this number Prof. Dufet studies the variation of the indices of refraction in mixtures of isomorphous salts, arriving at the experimental law that the differences between the indices of a mixture of two such salts and those of the component salts are in inverse ratio of the numbers of equivalents of the two salts forming the mixture; in other terms the curve which has for ordinates the indices and for abscissæ the equivalents, is a straight line. This law is regarded as a consequence of Gladstone's, on the constancy of specific *refractive energy* in mixtures.—M. Terquem describes an improved way of realising Plateau's liquid laminar systems, giving larger systems with less liquid. Instead of using pieces all rigid, he uses a combination of rigid pieces with flexible threads (silk), *e.g.*, two horizontal rods joined together at the ends with such threads or two rings joined with threads. Many instructive effects are thus had. The liquid used is a solution of soap and sugar, prepared in a special way.—M. Bouty contributes a mathematical paper on the number of elements necessary for determining the exterior effect of an optical system, and M. Bichat gives a new method of measuring the velocity of sound.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 21.—"On Repulsion resulting from Radiation." Part VI., by William Crookes, F.R.S., V.P.C.S.

In this part, with which the research closes, the author first examines the action of thin mica screens fixed on the fly of an ordinary radiometer, in modifying the movements. It is found that when a disk of thin clear mica is attached 1 millim. in front of the blacked side of the vanes of an ordinary radiometer, the fly moves negatively, the black side approaching instead of retreating from the light. When a thin mica disk is fixed on each side of the vanes of a radiometer, the result is an almost total loss of sensitiveness.

In order to examine the action of screens still further an instrument is described having the screens movable, and working on a pivot independent of the one carrying the fly, so that the screens can move freely and come close either to the black or to the white surfaces of the disks. By gentle tapping the screens can be brought within 2 millims. of the black surfaces. A candle is now brought near, shaded so that the light has to pass through one of the clear disks and fall on the black surface. The black side immediately retreats, the clear disk remaining stationary for a moment, and then approaching the light. If the candle is allowed to shine on the plain side of the black disk, no immediate movement takes place. Very soon, however, both disks move in the same direction away from the candle, the speed of the clear disk gradually increasing over that of the blacked disk.

Instead of allowing the clear screens to freely move on a pivot, an instrument was made in which the screens could be fixed beforehand in any desired position in respect to the blacked disk. It was then found that with the screens close to the blacked sides of the vanes the fly rotates very slowly in the negative direction, stopping altogether when the candle is moved five or six inches off. With the screens 1 millim. from the black surface the direction is negative, and the speed at its maximum. When the screens and disks are 7 millims. apart a position of neutrality is attained, no movement taking place. When the distance is further increased, positive rotation commences, which gets stronger as the screens approach the bright sides of the disks, where the positive rotation is at its maximum. The author adduces reasons for considering that the negative rotations here observed are caused by the warming up of the black surface by radiation falling direct on it, through the clear mica screen, and the deflection backwards of the lines of molecular pressure thereby generated.

The action of these radiometers being complicated, owing to the surfaces of the vanes being different in absorptive power, another instrument was made in which the vanes were of polished aluminium, perfectly flat and symmetrical with the bulb. The screens were of clear mica movable in respect to the vanes, and at right angles to their surface. When exposed to the light of a candle it was found that with the screens brought up close to the disks, the rotation was as if the unscreened side were repelled; at an intermediate position there was neutrality. Explanations are given of these movements, but without the illustrative cuts they would be unintelligible.

Experiments on radiometers having movable screens interposed between the vanes and the bulb are next given, and these are followed by a long series of experiments on the influence of movable screens on radiometers with cup-shaped metallic vanes, the screens being varied in shape and position in respect to the plane of rotation, as well as in respect to the distance from the vanes.

A similar series is given with metallic cylinders as vanes, and from the behaviour of the latter kind of radiometer an explanation is given of the various movements previously obtained. It is found that when the screen touches the convex surface of the vanes the rotation under the influence of light is always positive. It commences at a low exhaustion, increases in speed till the rarefaction is so high that an ordinary radiometer would begin to lose sensitiveness, and afterwards remains at about the same speed up to the highest rarefaction yet obtained. At any rarefaction after 87 M (millionths of an atmosphere) there is a neutral position for the screen. When it is on the concave side of this neutral position the direction of rotation is positive, and when on the convex side of the neutral position it is negative; the speed of rotation is greater as the vanes are further removed from this neutral position on either side. The position of this neutral point varies with the degree of exhaustion; thus at 12 M the screens must be 3 millims. from the convex side; at ·18 M they must be 13 millims. from the convex side. The higher the exhaustion the greater the distance which must separate the convex side of the hemi-cylinders and the screens.

The author gives explanations of these phenomena based on the following already ascertained facts:—When thin aluminium vanes are exposed to light the metal rises in temperature and becomes equally warm throughout, and a layer of molecular pressure is generated on its surface. The thickness of this layer of pressure, or the length of the lines of force of repulsion varies with the degree of exhaustion, being longer as the exhaustion increases. The lines of force appear to radiate from the metal in a direction normal to its surface. The force of repulsion is also greater the closer the repelled body is to the generating or driving surface, and the force diminishes rapidly as the distance increases, according to a law which does not appear to be that of "inverse squares." Diagrams are given illustrating the author's explanation based on the above data.

An apparatus is next described not differing in principle from the last, but having, in addition to the aluminium hemi-cylinder and movable mica screen, a small rotating fly made of clear mica, mounted in such a way that it could be fixed by means of an exterior magnet in any desired position inside the bulb. The screen was also capable of adjustment by means of another magnet; the aluminium hemi-cylinder in this apparatus being fixed immovably. The adjustible indicator being very small in diameter in comparison to the other parts of the apparatus, and, being easily placed in any part of the bulb, was expected to afford information as to the intensity and direction of the lines of pressure when a candle was brought near the bulb. Experiments have been tried, *a*, with the screen in different positions in respect to the hemi-cylinder; *b*, with the indicator in different parts of the bulb; *c*, with the candle at different distances from the hemi-cylinder on one side or the other; *d*, with the degree of exhaustion varying between wide limits. It would be impossible to give an intelligible abstract of the results obtained with this apparatus without numerous diagrams It may, however, be briefly stated that they entirely corroborate the theories formed from a study of the behaviour of the instruments previously described.

The next part of the paper treats of the action of heat employed inside the radiometer. In a previous paper the author

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showed that phenomena feeble and contradictory when caused by radiation external to the bulb, became vigorous and uniform when the radiation was applied internally by the agency of an electrically-heated wire. It was hoped that some of the more obscure phenomena shown by the deep cups with movable screens in front (referred to above) might be intensified if set in action by a hot wire. Several inds of apparatus and experiments with them are described, but the results are too complicated to be given in abstract. One experiment proves that the direction of pressure is not wholly normal to the surface on which it is generated, but that some of it is tangential.

The author then describes the turbine radiometer, early specimens of which were exhibited before the Royal Society on April 5, 1876. In the ordinary form of radiometer the number of disks constituting the fly is limited to six or eight, a greater number causing interference one with the other and obstruction of the incident light. In the turbine form of fly there is no such difficulty, the number of vanes may be considerably increased without overcrowding, and with corresponding advantage. In the earlier turbine radiometers the flies were made of mica blacked on both sides, and inclined at an angle like the sails of a windmill, instead of being in a vertical plane. This form of instrument is not sensitive to horizontal radiation, but moves readily in one or other direction to a candle held above or below. A vertical light falling on the fly gives the strongest action, but rotation takes place, whatever be the incident angle, provided the light is caught by one surface more than by the other. Ether dropped on the top of the bulb to chill it causes rapid negative rotation. If the turbine radiometer is floated in a vessel of ice-cold water, and the upper portion exposed to the air of a warm room, it rotates rapidly in the positive direction, acting as a heat engine, and continuing so to act until the rotating fly has equalised the temperature of the upper and lower portions of the bulb. By reversing the circle of operations—by floating the turbine radiometer in hot water and cooling the upper portion of the bulb—the fly instantly rotates in the negative direction.

After describing experiments in which the same fly was made to rotate first in a large bulb and then in a small one at the same degree of exhaustion, the author proceeds to discuss the influence exerted by the inner side of the glass case of the radiometer as a reacting surface. A flat metal band was put equatorially inside a radiometer, and lamp-blacked, so that the molecular pressure generated under the influence of light should react between the fly and the black band, instead of between the fly and the glass side of the bulb. It was found that the maximum speed with the band present was 40 revolutions a minute, against 8¼ revolutions when the band was absent.

The rotation of the case of a radiometer, the fly being held immovable by magnetism, is next described. A preliminary note on this subject having already appeared in the *Proceedings*,[1] it need not be again described in detail. Many different forms of instrument for effecting this rotation are described, and their mode of action explained.

The reacting inner surface of the envelope being thus proved to be essential to the rotation of the fly, other instruments were made in which this necessary reaction is obtained in a more direct manner. In one, the radiometer is furnished with a fly carrying four flat aluminium vanes, polished on both sides. Three vertical partitions of thin clear mica are fixed in the bulb, with their planes not passing through the axis of rotation, but inclined to it, thus throwing the obliquity off the fly on to the case, and giving three fixed planes for the reaction to take place against. Candles arranged symmetrically round the bulb make the fly rotate rapidly against the edges of the inclined planes. Breathing gently on the bulb gives negative rotation. A hot glass shade inverted over the instrument causes strong negative rotation, changing to positive on cooling. When the fly is furnished with clear mica or with silver flake mica vanes, the same results are obtained as when aluminium vanes are employed. The principal action is produced by dark heat warming the bulb, screens, and vanes.

The *otheoscope* is the next subject treated on in the paper. This has already been given in abstract,[2] and need not be again referred to. Many different varieties of otheoscope are figured and described.

It was suggested by Prof. Stokes that a disk might be made to revolve on its axis, and the author describes an instrument in which this suggestion is carried out. The disk is horizontal, mounted like the fly of a radiometer, and for lightness' sake is of mica, blacked above. Fixed to the bulb above the disk are four flat pieces of clear mica; each extends from the side of the bulb to near the centre, and ends below in a straight horizontal edge, leaving just space enough for the disk to revolve without risk of scraping. The edge is in a radial direction, and the plane of the plates is inclined about 45° to the horizon in the same direction for them all. Exposed to the light of a candle the rotation is against the edge. By slightly modifying this form the instrument becomes much more sensitive.

Whilst experimenting with the otheoscope it was found that, for a given exhaustion, the nearer the reacting surfaces were together the greater was the speed obtained. In the *Proceedings* of the Royal Society for November, 1876,[1] the author described an apparatus by which he was able to measure the thickness of the layer of molecular pressure generated when radiation impinged on a blackened surface inclosed in an atmosphere the rarefaction of which could be varied at will.

It was found that in this apparatus repulsion could be obtained at ordinary atmospheric pressures. Observations are given at normal pressure and at various degrees of rarefaction, with the driving and moving surfaces separated 1, 2, 3, 4, 6, 8, and 12 millims.; and diagrams of the resulting curves are shown when the atmospheric tension and the force of repulsion are used as abscissæ and ordinates. The tables and curves show that the law of increase of the force with the diminution of the distance between the disks does not remain uniform at all rarefactions. At the lowest exhaustions the mean path of the molecules of the attenuated gas is less than 1 millim., as rendered evident by the force of repulsion diminishing rapidly as the distance increases. At exhaustions higher than 9 millims. this condition alters, and as the gauge approaches barometric height the molecular pressure tends to become uniform through considerable distances, the mean path of the molecules now being comparable with the greatest distance separating the surfaces between which they act.

A similar apparatus to the one in which the last experiments were tried was used to measure the action at pressures at and approaching atmospheric. At pressures between atmospheric and 210 millims. the first action is very faint repulsion, immediately followed by strong attraction. The attraction then begins to decline, until, at 15 millims. pressure, it disappears. At the same time the repulsion, which begins to be apparent at 250 millims., increases as the attraction diminishes. The author considers that the attraction is the result of air-currents, caused by the permanent heating of the surface in front of the movable disk.

The paper concludes with experiments undertaken to measure the amount of repulsion, using a horizontal torsion balance,[2] on the principle of Ritchie's, in which the force of repulsion is balanced by the torsion of a fine glass fibre. The *pan* of the balance is a clear mica disk, and a similar disk is fastened to the tube in which the beam oscillates. This fixed disk is lamp-blacked on the upper side, and beneath is a spiral of platinum wire, connected with terminals sealed through the side of the tube. When the spiral is ignited by a constant electric current the blacked mica disk fixed above it becomes heated, and the molecular pressure thereby generated between it and the mica pan causes the latter to rise. The glass thread attached to the beam is thus twisted, and by means of a graduated circle the number of degrees through which the thread has to be turned in order to bring the beam back to equilibrium is noted. This gives a measurement of the pressure exerted, in torsional degrees, and these are converted into grains by ascertaining how many torsional degrees correspond to a known weight. A ray of light reflected from a mirror in the centre of the beam is used as an index, being brought back to zero at each experiment. The author gives in a table, and also shows in the form of a curve, the results obtained with this apparatus, giving the force of molecular pressure in grains weight at exhaustions varying between 2,237 and 0·7 millionths of an atmosphere.

Mathematical Society, November 14.—Lord Rayleigh, F.R.S., in the chair.—The Treasurer's and Secretaries' reports having been read and adopted, Prof. W. G. Adams, F.R.S., consented to act as auditor.—The scrutators declared the following gentlemen elected as the Council for the ensuing session, viz., Mr. C. W. Merrifield, F.R.S., President; Prof. Cayley,

[1] *Proc.* Roy. Soc., No. 168, March 30, 1876.
[2] *Proc.* Roy. Soc., No. 180, April 26, 1877.

[1] *Proc.* Roy. Soc., No. 175, vol. xxv. p. 310.
[2] For a description of this form of torsion balance, see the author's paper, *Phil. Trans.*, 1876, vol. clxvi. pt. 2, p. 371.

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F.R.S., and Lord Rayleigh, F.R.S., Vice-Presidents; Mr. S. Roberts, F.R.S., Treasurer; Messrs. M. Jenkins and R. Tucker, Hon. Secretaries. Other Members: Mr. J. W. L. Glaisher, F.R.S., Mr. H. Hart, Dr. Henrici, F.R.S., Dr. Hirst, F.R.S., Dr. Hopkinson, F.R.S., Mr. A. B. Kempe, Dr. Spottiswoode, F.R.S., Prof. H. J. S. Smith, F.R.S., Mr. H. M. Taylor, and Mr. J. J. Walker.—Mr. Merrifield having taken the chair, Mr. J. D. H. Dickson was elected a Member, and Prof. W. S. Jevons, F.R.S., was proposed for election. The Rev. A. Freeman and Prof. Reinold were admitted into the Society.—The Chairman read a letter from Mr. Warren de la Rue, F.R.S., respecting a memorial to M. Leverrier.—The following communications were made to the Society:—On the instability of jets, by Lord Rayleigh.—On self-strained frames of six joints, by Prof. Crofton, F.R.S. (read by Mr. Hart).—On equivalent statements, iii., by Mr. H. McColl (abstract, read by Mr. Tucker).—The last paper contained a solution of a test problem to show the power of the author's method of elimination; then, an explanation, with illustrations and applications, of another allied method, called the "method of unit and zero substitution;" thirdly, a brief indication of the way in which this algebra of logic may render important service to scientific men in investigating the causes of natural phenomena; and lastly, a brief criticism of Prof. Jevons's method of solving logical problems.

Linnean Society, November 21.—Dr. Gwyn Jeffreys, F.R.S., vice-president, in the chair.—Dr. W. P. Kesteven exhibited, and a short note was read on some specimens of the so-called *Tête anglais* (*Melocactus communis*) from Vieuxfort, St. Lucia. There also was exhibited roots, tendrils, and tubers in different stages of *Vitis gongylodes* and *V. cuspidata*, illustrating the paper immediately thereafter read, viz.: On branch tubers and tendrils of *Vitis gongylodes*, by Mr. R. Irwin Lynch. Subterraneous tubers are by no means rare among plants, *e.g.*, the potato, but in contrast those of *V. gongylodes* present on the stem are aerial, at a height, and on dropping to the ground strike root. Cylindrical, of considerable size, and tenacious of life, they doubtless are a safeguard in propagation of the plant under circumstances prejudicial to the seed. The tendril possesses terminal adhesive disks, and these are formed without the stimulus of contact with any substance, therefore opposed to certain other climbers mentioned by Mr. Chas. Darwin. The aerial roots are of great length, eleven feet and more, they spring from each node, and are of a rich crimson colour in summer, so that they are attractive objects as seen in the Victoria House at Kew.—Report on the Mollusca of the *Challenger* expedition, by the Rev. R. Boog Watson. After introductory remarks, the author describes three genera of the Solenoconchia. Of these *Dentalium* has eighteen species, eleven being new. *Siphodentalium* has seven species, all new to science. Of *Cadulus* two only are already known, nine species and one variety being now recorded for the first time. In all, thirty-six species and four varieties, whereof twenty species were hitherto unknown. Some are of high interest, inasmuch as being remnants of genera now living which have existed since the cretaceous epoch.—The Secretary read the abstract of a paper by Mr. John Miers, on the Symplocaceæ. The author gives credit to Mr. Bentham for the earliest accurate knowledge of the group. The authors of the "Genera Plantarum" recently adopted the example of Prof. A. De Candolle, who regarded the Symplocaceæ as a mere tribe of the Styraceæ. This appears objectionable to Mr. Miers, who, with historical remarks, &c., gives grounds for his adverse opinion. Then follows a synopsis of, to him, eleven recognisable genera, with diagnoses of same, and lists of 125 species.—On the Algæ of Lake Nyassa, by Prof. Dickie, a brief communication, wherein he mentions being indebted to Dr. Laws, of the Livingstonia mission, for the collection. All the genera of the Algæ are known European forms, while the Diatomaceæ, with few exceptions, are likewise widely-diffused species, the only peculiar form being *Epithemia clavata*.—Messrs. Thos. Davidson, F.R.S., and Fred. Jas. Faraday, were elected Fellows of the Society.

Chemical Society, November 21.—R. Warington in the chair.—The following papers were read:—A chemical study of vegetable albinism, by Prof. Church. The author has made numerous analyses of white and green leaves of the same age from the same plant, in order to discover whether any difference in their composition could be detected. The leaves were gathered from the maple, the holly, the ivy, and three exotic plants. White leaves contain more water than corresponding green leaves, whilst the ash of white leaves contains more potash and phosphoric acid, but less lime, especially less oxalate and carbonate of calcium. Nearly sixty per cent. of nitrogen in the white leaves is non-albumenoid, while the green leaves contain thirty per cent. of nitrogen in that state. The author has also analysed a vegetable parasite, the dodder, and its host, the red clover; he finds that the white leaves resemble in composition the parasite, while the host represents the green leaves. The white leaf is therefore, in a sense, a parasite on the green leaf, and owes its existence to its connection with the normal portion of the plant.—Relation between the melting-points of the elements and their coefficients of expansion, by Dr. Carnelly. The author finds that, of thirty-one elements, twenty-six show that the coefficient of expansion increases as the melting-point diminishes; the five exceptions are arsenic, antimony, bismuth, tellurium, and tin.—A preliminary notice on a hydride of boron, by F. Jones. The author succeeded in preparing a grey friable mass of magnesium boride by strongly heating a mixture of magnesium dust and boron trioxide. On heating this mass with hydrochloric acid, a colourless gas was evolved, spontaneously inflammable, burning with a green flame, and of disagreeable odour.

Zoological Society, November 19.—Mr. A. Grote, vice-president, in the chair.—Mr. Sclater exhibited and made remarks on an adult specimen, in full plumage, of the black-throated stonechat (*Saxicola stapazina*), which had been obtained in Lancashire, and had been sent for exhibition by Mr. R. Davenport. The species had not been previously recorded as occurring in the British Isles, and was an interesting addition to the list of "Accidental Visitors."—The Secretary read two letters he had received from Dr. A. B. Meyer and Mr. A. D. Bartlett in reference to the communication read at the last meeting from Mr. Everett respecting the supposed existence of the anoa (*Anoa depressicornis*) in the Philippines.—Prof. Owen, C.B., read a memoir on the relative positions to their constructors of the chambered shells of cephalopods.—Sir Victor Brooke, Bart., read a paper on the classification of the Cervidæ, and gave a synoptical list of the existing species of this family.—A second paper by Sir V. Brooke contained the description of a new species of gazelle from Eastern Africa, which the author proposed to name *Gazella walleri*, after its discoverer, Mr. Gerald Waller.—Prof. A. H. Garrod, F.R.S., read a paper on the anatomy of *Indicator major*, and showed that, as regards its soft parts, as in its osteology, *Indicator* is not related to the cuckoos, but to the barbets and toucans.—A communication was read from the Marquis of Tweeddale, F.R.S., containing the eleventh of his contributions to the ornithology of the Philippines. The present paper gave an account of the collection made by Mr. A. H. Everett at Zamboanga, in the Island of Mindando. Ninety-eight species were obtained in this locality by Mr. Everett, of which eleven were new to the Philippine fauna and six were new to science.—Mr. E. R. Alston read some notes supplementary to his paper on the squirrels of the neotropical region.

Entomological Society, November 6.—Mr. H. W. Bates, F.L.S., F.Z.S., president, in the chair.—Mr. Waterhouse exhibited a specimen of *Chauliognathus excellens* (*Telephoridæ*), a new beetle from New Granada.—Mr. H. T. Stainton exhibited a new horn-feeding *Tinea* (*T. orientalis*), which had been reared by Mr. Simmons, of Poplar.—The Rev. H. L. Gorham exhibited some rare British beetles, taken in the neighbourhood of Horsham, Sussex.—Mr. Goss exhibited specimens of a rare dragon fly (*Cordulia curtisi*) from Christchurch, Hampshire.—Mr. Meldola exhibited a male specimen of the moth *Erebus odorus*, from Jamaica, possessing large tufts or brushes on the hind leg, which were considered as probably scent-secreting organs.—Prof. Wood Mason exhibited drawings and made remarks on the flower simulating *Mantidæ*.—Mrs. Randolph Clay exhibited a living specimen of a beetle (*Zopherus bremêi*), from Yucatan, worn as an ornament.—Sir Sydney Saunders exhibited specimens of *Blastophaga psenes* (Linn.), employed in the process of cuprification, received from Mr. J. Lichtenstein, of Montpellier.—Also specimens of *Sycophaga crassipes*, West., from the sycamore figs of Egypt, together with certain apterous associates.—The Secretary read a communication from the Board of Trade with reference to the damage done to the corn crops in the neighbourhood of Mariapol by swarms of the beetle *Anisoplia Austriaca*.—A sub-committee was appointed to draw up a report on the same.—Miss E. A. Ormerod read a paper on *Psila rosæ*, the well-known insect producing the so-called "rust" in carrot crops.

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She advocated the use of a phenol preparation for the destruction of this pest.—Mr. C. O. Waterhouse read a paper containing descriptions of new *Telephoridæ* from Central and South America.—Sir Sydney Saunders communicated a paper on the habits and affinities of *Sycophaga* and *Apocrypta* from the sycamore figs of Egypt.—Mr. Distant communicated descriptions of new species of Hemiptera-Homoptera.

Geological Society, November 6.—Henry Clifton Sorby, F.R.S., president, in the chair.—Arthur Goodger, Rev. Walter Howchin, Lieut.-Col. C. A. McMahon, Oswald Milton Prouse, and M. G. Stuart, were elected Fellows of the Society.—The following communications were read :—On the range of the mammoth in space and time, by Prof. W. Boyd Dawkins, F.R.S. The author expressed his opinion that the result of the evidence collected since the death of Dr. Falconer has been to establish the view of that palæontologist as to the mammoth having appeared in Britain before the glacial epoch. The evidence as to the occurrence of the mammoth in the south of England was first examined. The remains found beneath the bed of erratics near Pagham belonged, not to *Elephas primigenius*, but to *E. antiquus*. But in 1858 remains belonging to the former were found by Prof. Prestwich under boulder-clay in Hertfordshire. In Scotland remains of *E. primigenius* have been found under boulder-clay, but whether under the oldest boulder-clay is uncertain. In 1878 a portion of a molar was brought up from a depth of sixty-five feet near Northwich. It was in a sand beneath boulder-clay, which the author considered to be undoubtedly the older boulder-clay. The author now assents to Dr. Falconer's opinion (which he formerly doubted) that *E. primigenius* was a member of the Cromer forest-bed fauna. It is also clear that it was living in the southern and central parts of England in post-glacial times. It has not been found north of Yorkshire on the east and Holyhead on the west, probably because Scotland and north-west England were long occupied by glaciers. Its remains have been found on the continent as far south as Naples and as far north as Hamburg, but not in Scandinavia. Its remains, as is well known, abound in Siberia, and it ranged over North America from Eschscholtz Bay to the Isthmus of Darien, *E. columbi*, *E. americanus*, and *E. Jacksoni* being only varieties. The author then discussed the relations of *E. primigenius* to *E. columbi*, *E. armeniacus*, and *E. indicus*, and came to the conclusion that it is the ancestor of the last.—The mammoth in Siberia, by H. H. Howorth, F.S.A. Communicated by J. Evans, LL.D., F.R.S. The author discussed the theories which account for their presence :—1. That the animals lived much further south, and were carried down by rivers to where they now lie; 2. That they lived on the spot. As there are physical difficulties in the way of the transport theory, as the mammoth was covered with dense hair and fed on plants growing on the spot, and as the remains are not confined to the vicinity of rivers, it is probable that the second view is the correct one. It seems probable that the climate of Siberia has become more severe. The author considered the cause of the mammoth's extinction. This he held to have been sudden. The remains must have been preserved after death. He therefore maintains that they were destroyed by a flood due to some sudden convulsion which also changed the climate.—On the association of dwarf crocodiles *Nannosuchus* and *Theriosuchus pusillus*, *e.g.*) with the diminutive mammals of the Purbeck series, by Prof. R. Owen, C.B., F.R.S. The author noticed an objection which had been raised to his view of the origin of the differences between the mesozoic and neozoic crocodiles by the adaptation of the latter to the destruction by drowning of large mammalia (*Q. J. G. S.*, xxxiv. p. 422), namely, that mammals were coexistent with the mesozoic forms, and remarked that from their small size they would hardly constitute a suitable prey for the crocodiles to which he then specially referred, but would be more likely to perform the same part as the ichneumons of the present day, which check the increase of crocodiles by destroying their eggs and newly-hatched young. He stated, however, that in waste slabs of "feather-bed" marl which accompanied the Becklesian Purbeck Collection to the British Museum, the remains of small crocodiles were detected in considerable abundance; and he gave a description of these, and especially of one which he named *Theriosuchus pusillus*. This reptile, which is estimated to have been about eighteen inches long, had scutes presenting the "peg and groove" character of those of *Goniopholis*, with which genus it further agreed by having the antorbital part of the skull of the broad-faced alligator type. In the dentition it resembled the triassic theriodonts more than any other crocodiles. The vertebræ are amphiplatyan. In conclusion, the author indicated the conditions which have to be fulfilled in the case of recent crocodiles to enable them to drown a large mammal without inconvenience to themselves, and showed that these conditions were realised also in the neozoic forms, whilst there was no reason to suppose that any mesozoic crocodiles possessed the adaptations in question.

Anthropological Institute, November 12.—Mr. John Evans, D.C.L., LL.D., F.R.S., president, in the chair.—The following new Members were announced :—Mr. M. J. Gabriel, and Mr. George H. Radford.—Mr. Robert Cust read a report on anthropological proceedings at the Oriental Congress, in which he gave a digest of all the papers and discussions at that Congress which appertained to the science of anthropology.—Mr. Park Harrison read a paper on some characters which are still in use as tattoo-marks by the Motu, a people located in the South-Eastern Peninsula of New Guinea, and described by the Rev. Dr. Turner as a superior race to the Papuans, from whom they differ both in colour and customs. About half of the more distinctive forms tattooed on a Motu girl, carefully copied by Dr. Turner, correspond with letters in the Asoka inscriptions in India, which are believed to be allied to Phœnician, whilst several others resemble letters admittedly derived from the same stock, but independently acquired. The marks are mostly arranged in groups of three; on the right arm, however, nine or ten are apparently connected by a line running above them all. The characters are twenty-three in number, and are formed of straight lines in the following combinations; viz., five of 2 lines, nine of 3 lines, five of 4 lines, and three of 5 lines, much in the same proportion as in the Rejang and Lampong alphabets of Sumatra, the letters of the former of which have been shown to be identical with Phœnician characters *reversed*. Archaic forms of letters have also been met with in several islands of the Indian Archipelago and Melanesia, but are now without meaning. The Motu characters are used simply for ornament or as charms. As an example of the use of letters for tattoo-marks, the case of the Austrian subject was cited, who, having been taken prisoners in Burmah, a few years ago, was there tattooed with letters and other patterns. Besides the characters on the Motu girl, there were various pictures, or hieroglyphics, consisting of eyes and eyebrows, a lunar crescent, and other forms.

Meteorological Society, November 20.—Mr. C. Greaves, F.G.S., president, in the chair.—Rev. T. L. Almond, Rev. T. C. Beasley, F. T. Bircham, H. F. Blanford, G. Chatterton, E. Easton, W. L. Fox, G. F. Lyster, Lieut.-Col. W. Stuart, R. Tennent, and H. Yool were elected Fellows of the Society.—The following papers were read :—Report on the phenological observations for 1878, by the Rev. T. A. Preston, M.A.—Upbank thaws, by the Rev. Fenwick W. Stow, M.A.—Comparison of thermometric observations made on board ship, by Capt. H. Toynbee, F.R.A.S.

PARIS

Academy of Sciences, November 11.—M. Fizeau in the chair.—M. Loewy presented a memoir by M. Stephan and himself, on determination of the two differences of longitude, Paris-Marseilles and Algiers-Marseilles. He remarked, on the difference of velocity in transmission of signals through air and under water, that this velocity was found about 36,000 kilom. per second in the former case and 4,000 kilom. in the latter, numbers agreeing closely with those got lately by Dr. Albrecht, in Prussia, from shorter lines.—On the vision of colours, &c., second extract from work by M. Chevreul.—On the dilatation of heated bodies and the pressures they exercise, by M. de Saint Venant.—On the energy of a body and its specific heat, by M. Clausius.—Report on a memoir of M. Popoff, entitled, "New Researches relative to Expression of the Conditions of Motion of Water in Sewers." This shows the necessity of new formulæ, involving either change of known numerical coefficients or consideration of the movement as being generally varied. Several problems are enunciated as needing solution.—On measurement of the magnifying power in optical instruments, by M. Govi. It is inexact to say such and such a lens or microscope magnifies a certain number of times the image of objects, while it is not added at what distance the image must be for this magnification to take place. The distance of distinct vision is variable.—On the possibility of obtaining, with protoxide of nitrogen, an insensibility of long duration, and on the harmlessness of this anæsthetic, by M.

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Bert. He recommends putting patients in an apparatus with the pressure raised to two atmospheres, and making them breathe a mixture of 50 per cent. protoxide of nitrogen and 50 per cent. air; thus long anæsthesia is had, while the normal quantity of oxygen is kept up in the blood.—Observations on M. Levy's memoir on a universal law relating to the dilatation of bodies, by M. Massieu. —On the transformation of linear forms of prime numbers into quadratic forms, by M. Oltramare.—Artificial crystallisation of orthose, by M. Meunier. The author obtained this (which MM. Fouqué and Levy are now seeking to effect) some years ago, by devitrification of the vitreous masses called retinites.—New process for application of galvanoplasty to conservation of nervous centres, by M. Oré. A hardened brain is dipped in fused gutta percha, and the gutta percha, on hardening, is divided and separated, forming a mould; this is lined with black lead and put in a nickelising bath; thus a hollow piece is had faithfully reproducing the brain.—Resistance of some wild types of American vines to phylloxera, by M. Millardet.—On the reduction of certain differential equations of the first order to linear form with reference to derivatives of the unknown function, by M. Halphen.—On the form of integrals of differential equations in the neighbourhood of certain critical points, by M. Picard.—On the theory of machines of the Gramme order, by M. Breguet. To obtain the best possible effect from a system formed by a movable circuit rotating in a magnetic field (1) if the motion is caused by a current of foreign source, the diameter of the points of contact should be displaced in the direction opposite to the rotation, and through a greater angle the greater the intensity of the current and the weaker the magnetic field; (2) if the motion has to generate a continuous current in the apparatus the same diameter should be displaced in the direction of the rotation.—Chemical researches on tungstates of earthy and metallic sesquioxides, by M. Lefort.—Analysis of different metallic fragments from the Peruvian burying-places of Ancon, near Lima, by M. Terreil. This reveals the presence of brass in these tombs belonging to the sixteenth century.—Synthesis of uric derivatives of the alloxane series, by M. Grimaux.—On some causes of inversion of cane sugar, and on the consecutive alterations of the glucoses formed, by M. Durin. The causes referred to are heat, water, and time (without pre-existent glucose), the phenomenon being purely chemical.—On the hatching of bees, by M. Girard.—Specific determination of fossil or ancient bones of Bovides, by M. Sanson. The bones of Bovides found in beds before the present geological epoch belong to the groups of bisons and bulls: the first, all to one species, now living (*B. americanus*), the second to four living species (specified).—On the presence of alcoholic ferment in air, by M. Miquel. Sterilised must exposed among the vineyards of the south of France always ferments in a few days; this is attributed to conveyance of wine-yeast by insects. He shows that the air really transports yeast. In the Montsouris Park, Paris, not a single case of spontaneous alcoholic fermentation was met with.—Organisation of *Hydrocrosis arsenicus*, Bret., by M. Marchand.

November 18.—M. Fizeau in the chair.—The following papers were read:—Meridian observations of small plants at the Greenwich and Paris Observatories, during the third quarter of 1878, communicated by M. Mouchez.—On a fresh discovery of Silurian terestrial plants in the slaty schists of Angers, by M. Crié; note by M. de Saporta. This is the frond of a fern resembling most nearly *Cardiopteris polymorpha*, Gœpp., which characterises the carboniferous limestone of Silesia; but it has also special features. (A figure is given.)—Means of measuring the manometric value of the pressure of the blood in man, by M. Marey. This consists in producing on a part of the body surface a known counter-pressure with water, capable of overcoming the blood-pressure in the vessels. The simple immersion of a finger in a suitable apparatus suffices; it has shown that in some adynamic fevers the blood pressure may fall to 3 ctm., while in interstitial nephritis it may rise above 20 ctm.—New remarks on M. Levy's communication, on a universal law relating to dilatation of bodies, by Prof. Boltzmann.—Observations on MM. Gruey and Hirn's notes regarding a gyroscopic apparatus, by M. Sire.—On an alterating gyroscopic tourniquet, by M. Gruey. —On a new system of electric lamp, by M. Werdermann. —Artificial reproduction of felspars and of a complex volcanic rock (pyroxenic labradorite) by the method of igneous fusion, and prolonged maintenance at a temperature near fusion, by MM. Fouqué and Levy.—Migration of pucerons of galls of lentiscus to the roots of Gramineæ, by M. Lichtenstein.—M. Oder presented (through M. du Moncel) an electrophone, with which words and notes can be heard 5 m. off. On one end of a sort of drum is fixed a diaphragm of parchment paper, having at the centre six small bars of white iron, fixed circularly, on which act six very small horseshoe electro-magnets connected together and actuated by a carbon microphone. The strong effects are attributed to the smallness of the magnets, giving more rapid magnetisation or demagnetisation.—Intra-Mercurial planets observed during the solar eclipse of July 29. Letter from Mr. Watson. A reply to questions.—On the development of surfaces whose linear element is expressible by a homogeneous function, by M. Levy, —Note on the determination of imaginary roots of algebraic equations, by M. Farkas.—Action of hydracids on sulphate of mercury; action of sulphuric acid on the haloid salts of this metal, by M. Debray. Sulphate of mercury gently heated in hydrochloric gas absorbs it with liberation of heat, and yields a matter fusible and volatile without decomposition, condensing in fine white needles; it has the formula $HgO,SO_3 + HCl$. It may be had directly by union of mercuric chloride and monohydrated sulphuric acid.—Peculiar action of platinum wire on hydrocarbons; modification of the grisoumeter, by M. Coquillion. Bicarbide of hydrogen mixed with air is more detonant than protocarbide; palladium gives a less detonation than platinum; and these two metals can equally burn at red-white small quantities of gas. Thus platinum may be substituted for palladium where there is no fear of detonations.—On the alkalinity of carbonates and silicates of magnesia, free, mixed, and combined, by M. Pichard.—Action of the cervical sympathetic on the pressure and velocity of the blood, by MM. Dastre and Morat. An unforeseen result is that the initial constriction on stimulation of the nerve is always followed by a dilatation greater than that which follows section of the nerve.—On the toxical power of the extract of seeds of hemlock, by MM. Bochefontaine and Mourrut. The common extract obtained from the whole plant is often almost without action; not so extract from the dry seeds; it is in them the active principle specially resides.—On a disease of lettuce (*Peronospora gangliiformis*, Berk.), by M. Cornu.—On the morphology of dicotyledonous stems, by M. Guinier. He applies the graphic method. *Inter alia*, at heights under 1,400 metres, stems bulge out about the middle; as you go higher, the swelling disappears, and about 1,700 m. height, it is replaced by a concavity. From the leafy head of trees may be deduced the form of the stem.—Observations on the orography of the chain of the Pyrenees, by . Schrader.

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